List of Potential Target NEOs for Human Missions

Abstract

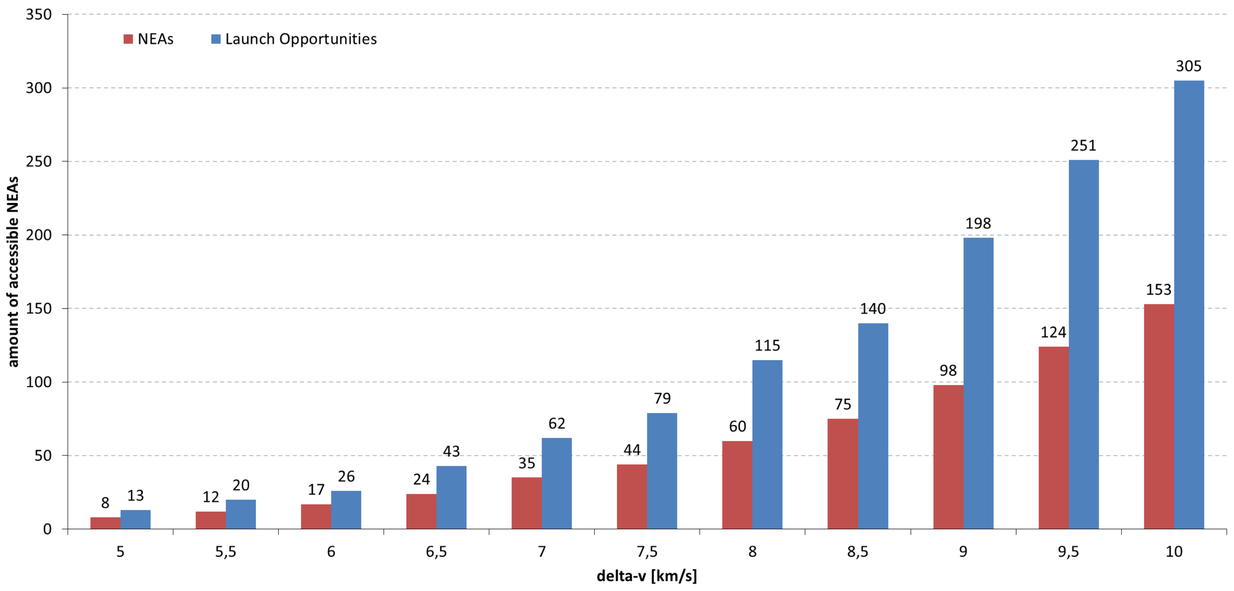
During the last decade the interest in exploration missions towards Near Earth Objects (NEOs) has grown and many studies have been published. This paper précises appropriate constraints for the selection of potential target asteroids, i.e. Earth close approach distance under 0.2 AU between 2015 and 2050, 180 days mission duration, residence time, asteroid characteristics (size, rotation rate) and re-entry velocity. On that basis and using the actual ephemeris data of the JPL HORIZONS system, a list of NEOs has been calculated for exploration missions requiring a total delta-v of between 5 and 10 km/s.

- **In all past studies the minimum delta-v for an impulsive mission to an asteroid coincides with the asteroid's close approach to Earth.***
- **Close approaches up to 0.2 AU (~30 Mill. km) as a mean value of other studies count as an appropriate limit for further calculation.**
- **Consequently the baseline data for all figures of this poster are asteroids taken from the NASA Horizons server (on the 16. Sept. 2013) with an Earth close approach of under 0.2 AU between 2015 and 2050.**

* S. Wagner and B. Wie, "Target Asteroid Selection for Human Exploration of Near Earth Objects," Iowa State University, USA, 2010.
A. Zimmer and E. Messerschmid, "Target Selection and Mission Analysis of Human Exploration Missions to Near-Earth Asteroids," Institute of Space Systems, University of Stuttgart, Germany, 2011.

- **It is assumed that transfer stages and the manned capsule are assembled in a circular park orbit of 200 km altitude around Earth.**
- **Starting from there the mission phases consist of the Earth departure manoeuvre (EDM), outbound time of flight (out TOF), asteroid arrival manoeuvre (AAM), stay time on/at the asteroid, asteroid departure manoeuvre (ADM), inbound time of flight (in TOF) an re-entry into Earth's atmosphere and landing.**
- **The overall mission time beginning with the EDM shall stay within 180 days.**
- **All calculated delta-v are minimum delta-v solving the lambert's problem.**

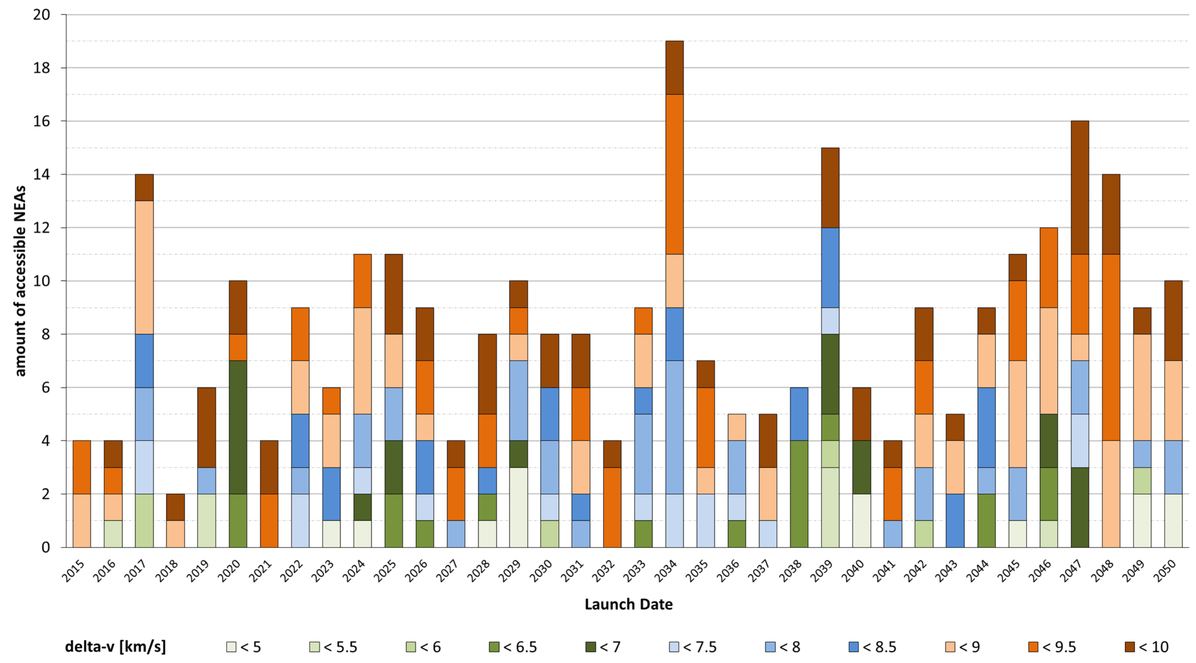
Accessible NEAs and launch opportunities for a 180 days mission and launch dates from 2015 to 2050 dependent on delta-v



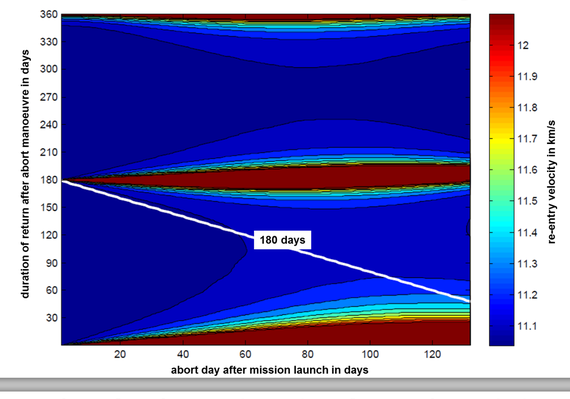
List of potential NEA missions with a maximum need of 7 km/s delta-v

name	launch date	out TOF	stay time [in days]	in TOF	dV EDM	dV AAM	dV ADM [in km/s]	v reentry	dV total
'1991 VG'	18.07.2017	83	10	87	3,29	1,02	1,25	11,20	5,57
	16.07.2017	84	10	86	3,29	1,00	1,28	11,20	5,56
	07.12.2038	104	10	66	3,40	1,44	1,37	11,29	6,21
	10.12.2038	103	10	67	3,40	1,49	1,32	11,27	6,21
'1997 YM9'	27.12.2044	68	10	102	4,01	0,70	1,64	11,76	6,34
	26.12.2044	69	10	101	4,00	0,72	1,65	11,76	6,36
'1999 AO10'	21.08.2025	131	10	39	3,26	2,23	1,14	11,37	6,64
'1999 CG9'	20.08.2033	117	10	53	3,47	1,24	1,75	11,36	6,46
'2000 LG6'	01.01.2036	125	10	45	3,23	2,00	1,11	11,27	6,34
'2000 SG344'	27.04.2028	45	10	125	3,30	0,85	2,28	11,09	6,43
	27.01.2029	92	10	78	3,29	0,84	0,67	11,17	4,80
	03.07.2029	81	10	89	3,25	0,60	0,80	11,09	4,65
	04.07.2029	80	10	90	3,25	0,60	0,80	11,09	4,65
'2001 FR85'	31.03.2039	108	10	62	3,55	0,92	0,89	11,47	5,36
	23.09.2039	67	10	103	3,56	0,60	1,16	11,43	5,32
	25.09.2039	67	10	103	3,57	0,58	1,15	11,43	5,31
	22.03.2040	70	10	100	3,57	1,51	1,55	11,38	6,63
'2001 GP2'	06.04.2020	144	10	26	3,27	3,04	0,58	11,33	6,88
'2003 LN6'	20.12.2025	134	10	36	3,28	3,16	0,50	11,73	6,93
'2003 SM84'	13.03.2040	86	10	84	3,31	2,06	1,43	11,22	6,80
	28.03.2046	86	10	84	3,28	1,67	1,59	11,14	6,55
'2005 LC'	18.12.2039	116	10	54	3,27	2,11	1,20	11,29	6,58
'2006 DQ14'	29.08.2030	91	10	79	3,72	1,53	0,49	11,57	5,73
'2006 QQ56'	05.03.2050	98	10	72	3,28	0,82	0,86	11,13	4,96
	04.03.2050	99	10	71	3,28	0,82	0,86	11,13	4,96
'2006 RH120'	16.06.2028	79	10	91	3,20	0,74	0,68	11,06	4,61
'2007 PS9'	06.08.2046	75	10	95	4,07	0,76	1,29	11,95	6,13
	05.08.2046	75	10	95	4,06	0,78	1,29	11,95	6,14
'2007 UN12'	24.07.2020	92	10	78	3,50	1,14	1,95	11,40	6,59
	22.07.2020	93	10	77	3,49	1,09	2,01	11,42	6,59
	17.04.2049	92	10	78	3,40	1,75	0,79	11,29	5,94
'2007 UW1'	24.04.2039	118	10	52	3,95	2,10	0,94	12,16	7,00
'2007 XB23'	11.12.2024	59	10	111	4,09	0,11	0,31	11,87	4,51
'2008 EA9'	24.11.2019	83	10	87	3,32	0,52	1,40	11,16	5,24
	23.11.2019	83	10	87	3,32	0,51	1,42	11,16	5,24
'2008 HU4'	06.04.2016	41	10	129	3,24	0,64	1,29	11,05	5,17
	21.12.2046	84	10	86	3,35	1,74	1,59	11,30	6,68
'2008 JL24'	16.09.2025	97	10	73	3,47	1,63	1,02	11,43	6,13
	16.09.2025	97	10	73	3,47	1,63	1,02	11,43	6,13
	06.02.2026	77	10	93	3,40	1,21	1,69	11,22	6,29
'2008 LD'	28.05.2024	46	10	124	4,00	0,64	2,32	11,52	6,96
'2009 BD'	04.04.2046	63	10	107	3,25	0,73	1,14	11,06	5,13
'2009 OS5'	15.02.2020	105	10	65	3,24	2,20	1,36	11,21	6,80
'2009 UY19'	28.10.2038	111	10	59	4,16	0,73	1,18	11,96	6,07
	25.10.2038	109	10	61	4,20	0,79	1,12	12,02	6,11
	24.04.2039	59	10	111	4,20	0,97	1,48	11,96	6,65
'2010 JW34'	30.04.2045	48	10	122	3,31	0,33	1,14	11,14	4,78
'2010 TE55'	01.08.2047	74	10	96	3,55	1,15	2,07	11,29	6,78
	29.07.2047	77	10	93	3,52	1,13	2,12	11,31	6,78
	01.08.2047	74	10	96	3,55	1,15	2,07	11,29	6,78
'2010 UC'	29.09.2020	64	10	106	3,60	1,21	1,52	11,31	6,33
	30.09.2020	63	10	107	3,61	1,22	1,49	11,32	6,32
'2010 UE51'	01.08.2023	97	10	73	3,19	1,05	0,66	11,07	4,90
'2010 VQ98'	25.04.2040	80	10	90	3,29	0,97	0,62	11,13	4,88
	24.04.2040	80	10	90	3,28	0,96	0,64	11,13	4,88
'2011 BL45'	01.07.2029	80	10	90	3,41	1,71	1,46	11,16	6,57
'2011 CL50'	25.12.2020	43	10	127	3,68	0,36	2,62	11,14	6,65
'2011 DV'	29.10.2039	126	10	44	4,50	0,84	0,62	12,27	5,96
	27.10.2039	125	10	45	4,57	0,92	0,60	12,36	6,09
'2011 MD'	12.06.2049	53	10	117	3,31	0,51	0,81	11,11	4,63
	13.06.2049	52	10	118	3,32	0,52	0,80	11,11	4,63
'2011 UD21'	16.08.2042	116	10	54	3,24	1,80	0,69	11,11	5,73

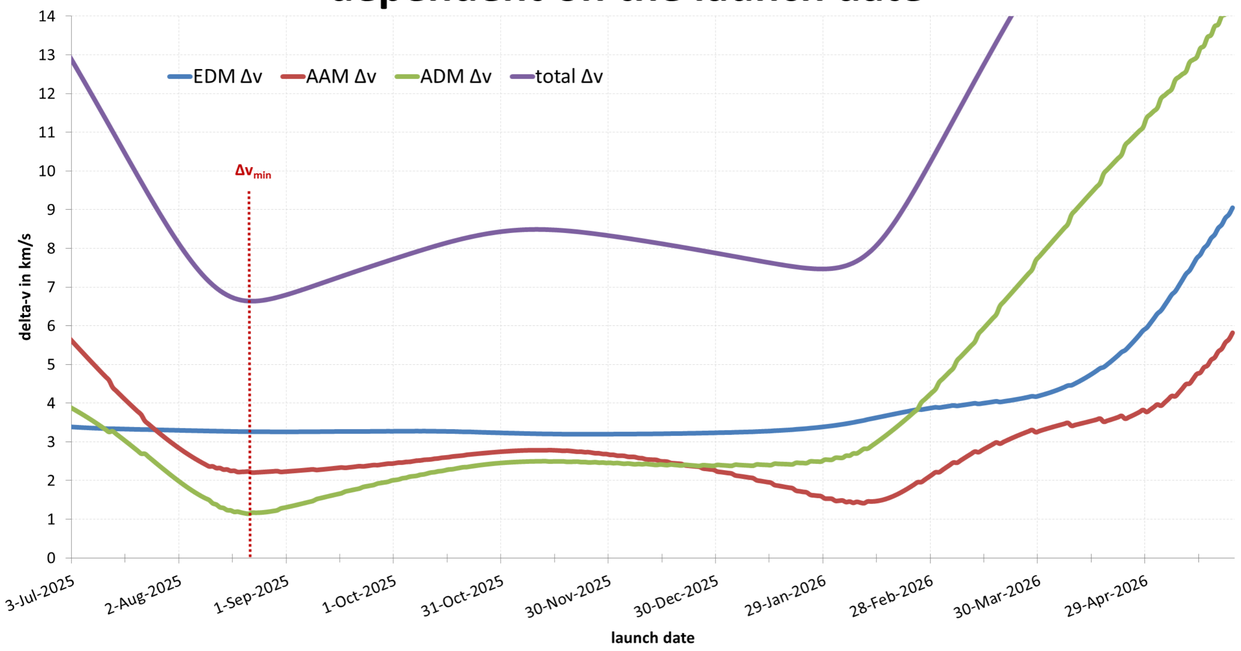
Accessible NEAs for a 180 days mission and launch dates from 2015 to 2050



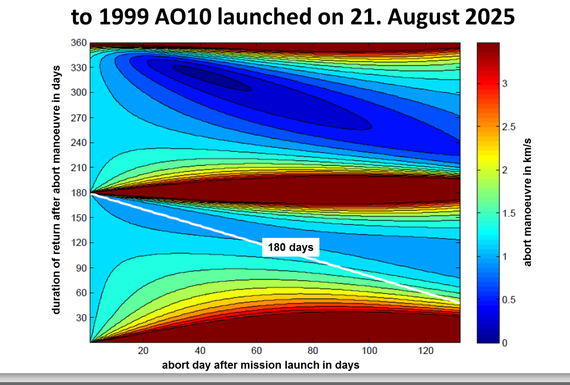
Re-entry velocities for abort trajectories of a 180 days mission to 1999 AO10 launched on 21. August 2025



Delta-v for a 180 days mission to 1999 AO10 dependent on the launch date



Delta-v for abort trajectories of a 180 days mission to 1999 AO10 launched on 21. August 2025



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